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Abstract

Background

The link between diet quality and socio-economic status (SES) may extend to the use of vitamin/ mineral supplements. This article examines factors related to Canadians' use of such supplements, with emphasis on associations with household income and education.

Data and methods

The data are from the 2004 Canadian Community Health Survey–Nutrition (n= 35,107). The prevalence of vitamin/mineral supplement consumption during the previous month was recorded. Supplement use at the national level was estimated by age/sex groups, SES and chronic conditions. Logistic regression was used to determine significant associations between socio-economic factors and vitamin/mineral supplement use. Estimates of usual calcium intake from food and from food plus supplements were obtained using SIDE-IML.

Results

The prevalence of supplement use was significantly higher in females than in males in all age groups 14 or older. Age, being female, high household income and education, and being food-secure were positively associated with supplement use. Supplement use substantially increased the percentage of the population, particularly older adults, meeting the Adequate Intake level for calcium.

Interpretation

The reported use of vitamin/mineral supplements varies by age, sex and SES. The relatively low prevalence of use among Canadians of low SES is similar to findings from American studies. These individuals, already at risk for inadequate intake from food, do not make up the difference with vitamin/ mineral supplements.

Keywords

calcium, diet, food security, nutrition, nutrition surveys, nutritional requirements

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The use of supplements can increase daily intake of vitamins and minerals (micronutrients) beyond what is obtained from food alone,[1,2] and thus, may confer health benefits, including chronic disease prevention.[3]

Some population groups have been identified as being at risk for low nutrient intakes.[4,5] Specifically, diet quality has been linked to socio-economic status (SES), with higher-quality diets being associated with greater affluence. People of lower SES tend to consume more high-caloric, nutrient-poor foods, whereas those of higher SES consume more whole grains, lean meats, fish, low-fat dairy products, and fresh vegetables and fruit.[6]

Vitamin/Mineral supplements offer the potential to improve the micronutrient intake of people with a nutrient-poor diet, in that the cost of regular retail supplements is less than that of foods such as fruits, vegetables, and dairy products.

However, according to the *inverse supplement hypothesis*,[7] people at risk for nutrient inadequacy, or in need of more nutrients because of disease risk, are not the ones who take supplements. In fact, a number of American studies have shown that the use of vitamin/ mineral supplements is also related to SES. Seven of ten studies that examined the association between income and supplement use among adults and children found a positive association.[7-13] A higher level of education was also a strong predictor of supplement use.[1,7,8,10,11,14-17]

With data collected by the 2004 Canadian Community Health Survey (CCHS) (cycle 2.2), it is possible to determine if the inverse relationship between vitamin/mineral supplement consumption and SES prevails in Canada.[1,2,18] The objective of the 2004 CCHS was to provide estimates of dietary intake in terms of nutrients, foods, food groups, dietary supplements, and eating patterns, at the national and provincial levels for a representative sample of Canadians. Because the CCHS collects demographic, socio-economic, health status and food security data, associations between these factors and vitamin/mineral supplement use can be examined.

For this analysis, it was hypothesized that people of high SES are more likely than those of lower SES to take supplements, but that other factors (age, sex) are also significantly associated with supplement use. Calcium, one of the most common mineral supplements, is used to demonstrate the impact of supplements on total intake.

Data and methods

Data source

From January through December 2004, the CCHS (cycle 2.2) interviewed 35,107 respondents. The survey excludes residents of institutions, the territories, Indian reserves, crown lands and some remote areas; members of the regular Canadian Forces; and military and civilian residents of Canadian Forces bases.

Cycle 2.2 had two components: 1) a general health component containing demographic and health information including the use of vitamin and mineral supplements, and 2) a dietary intake component based on (a) 24-hour recall(s). The details of survey methodology and data collection have been described elsewhere.[19] This study pertains to all cycle 2.2 respondents aged 1 or older (n=34,818).

Definitions

Respondents were asked to provide the bottle or package of each supplement that they took, and if possible, the drug identification number, which the interviewer could immediately check against the Drug Product Database. For each supplement, respondents reported the amount taken per day, week or month during the last month. Average daily consumption of each supplement was derived from these data. The April 2008 release of CCHS 2.2 contains three files including vitamin/mineral supplement use information. For this analysis, data from two files—vitamin and mineral supplement details and vitamin and mineral summary—were used. The variables of interest were overall supplement use and calcium intake from supplements.

Total annual household income was classified into four categories based on the number of people in the household: *lowest* (less than $15,000 if 1 or 2 people; less than $20,000 if 3 or 4 people; and less than $30,000 if 5 or more people); *lower-middle* ($15,000 to $29,999 if 1 or 2 people; $20,000 to $39,999 if 3 or 4 people; and $30,000 to $50,000 if 5 or more people); *upper-middle* ($30,000 to $59,999 if 1 or 2 people; $40,000 to $79,000 if 3 or 4 people; $60,000 to $79,999 if 5 or more people); and *highest* ($60,000 or more if 1 or 2 people; $80,000 if 3 or more people).

Respondents' education was classified into four categories according to the highest level they had attained: less than secondary graduation; secondary graduation; some postsecondary; and postsecondary graduation. Because preliminary analyses showed secondary graduation to be an important cutoff in terms of supplement use, a new variable was created, categorizing education into two levels: less than secondary graduation and secondary graduation or more.

Food security status was based on 18 CCHS questions designed to determine if households had been able to afford the food they needed in the previous 12 months. The Statistics Canada derived variable defines four categories: food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger.

Respondents aged 19 or older reported if they had been diagnosed by a medical professional with (a) chronic health condition(s) that had lasted or were expected to last six months or more. These included long-term mental conditions.

Information about dietary intake was collected from each respondent during a face-to-face interview. To help respondents recall what and how much they ate and drank in the past 24 hours, interviewers used the five-step Automated Multiple Pass Method.[20,21]

The caloric and nutrient content of the foods reported was derived from Health Canada's Canadian Nutrient File 2001b supplement, a recipe database, and a survey foods database containing foods not in the other databases.[19] A second recall was conducted 3 to 10 days later from a subset of about 30% of participants (n=10,786). Response rates to the first and second recalls were 76.5% and 72.8%, respectively.

Analytical techniques

Because a large majority—83%—of supplement users reported taking supplements every day the previous month (only 3.5% had taken supplements fewer than 15 days), for these analyses, it was assumed that all supplement users took them regularly.

Descriptive statistics were used to estimate the percentage of the population who took vitamin/mineral supplements, and the distribution of supplement users in various Dietary Reference Intake age/sex groups at the national level. Supplement use by adults (19 or older) was determined by household income, education, and food security status. Some analyses examined just two adult age groups: 19 to 50 and 51 or older.

The dietary intake data from the two 24-hour recalls were adjusted for within-subject variability to obtain between-subject distributions of estimated intakes; this process converts recall data that are not representative of habitual intake into estimates of usual intake.[19] This was done with the modified version of SIDE-IML (Software for Intakes Distribution Estimation).[19]

Calcium was chosen to illustrate the impact of taking a specific supplement.[22] Usual intake of calcium (mg/d) and the percentage of the population meeting the recommended value from food alone were calculated by age group and sex for the population aged 1 or older. The calculation was repeated after adding supplement intake values to food intake values, based on the first and second 24-hour recalls. Differences in calcium intake between supplement users and non-users were also examined.

Logistic regression was used to determine significant associations between supplement use and age, sex, household income, education, food security, chronic conditions, and urban/rural residence. Sampling weights were used to obtain unbiased estimates of population sizes. The bootstrap method, which takes the complex survey design into account, was used to estimate standard errors, coefficients of variation and confidence intervals. The absence

of overlapping 95% confidence intervals denoted statistical significance.[19] SPSS version 15 was used to merge CCHS 2.2 files, create new variables, and generate the final data set; SAS version 9, to obtain the usual intake of nutrients of interest using SIDE-IML; and STATA SE 10 for the other analyses, weighting and bootstrapping. Alpha was set at 0.05.

Results

Vitamin/Mineral supplements

Age was closely related to vitamin/mineral supplement use. Around 40% of children aged 1 to 8 took supplements (Table 1). The percentage declined through adolescence to less than 30% at ages 14 to 18 and then rose steadily with advancing age to about 60% among women and 40% among men aged 51 or older.

Overall, the prevalence of vitamin/mineral supplement use was significantly higher among females than males: 47% versus 34%. This difference prevailed among all age groups 14 or older and widened at older ages, with the greatest gap at ages 51 to 70. The highest prevalence of supplement use was among women aged 51 or older (60%), and the lowest, among boys aged 14 to 18 (23%).

Supplement use was generally more common among people in higher- than lower-income households (Figure 1). The exceptions were women aged 71 or older, among whom supplement use was high regardless of household income, and unexpectedly, men aged 19 to 30 and 71 or older in the lowest income households.

Supplement use also tended to rise with level of education (Figure 2). Among men, the difference between those who had not graduated from secondary school and those who had at least some postsecondary education was particularly pronounced.

Among women, as food insecurity became more severe, supplement use tended to decline (Table 2). Among men, the association between supplement use and food security followed a U-shaped pattern, with relatively high percentages of supplement users among those reporting the most severe level of food insecurity.

Many of the factors associated with taking supplements are, themselves, interrelated. For instance, household income and education are associated with each other, and food security tends to be associated with both. When logistic regression was used to control for these potentially confounding effects, age, sex, household income, education, food security and chronic conditions were found to be independently and significantly associated with supplement use.

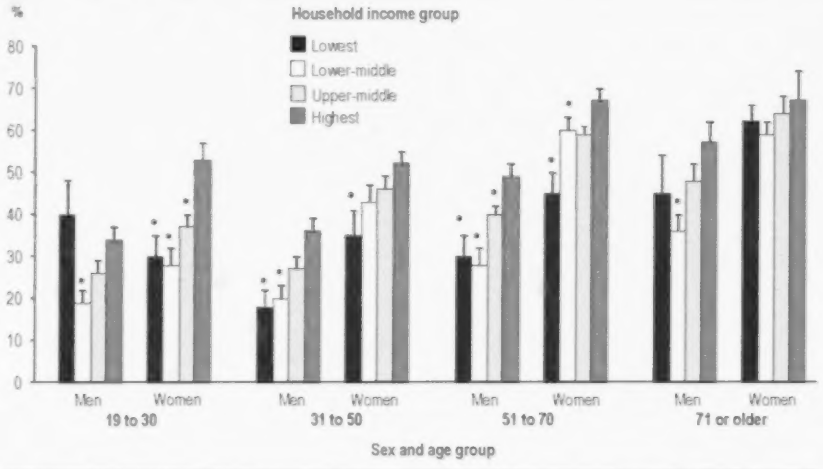
For example, compared with children aged 1 to 8, the only group significantly more likely to use supplements was women aged 51 or older; for all other age/sex groups, the odds of supplement use were significantly lower (Table 3). Household income and education were each independently related to supplement

Table 1
Prevalence of vitamin/mineral supplement use, by age group and sex, household population aged 1 or older, Canada excluding territories, 2004

	Male			Female		
		95% confidence interval			95% confidence interval	
Age group	%	from	to	%	from	to
Total	**33.5**	**32.0**	**34.9**	**46.9***	**45.5**	**48.3**
1 to 3	38.2	33.9	42.5	38.9	34.5	43.3
4 to 8	44.3	40.5	48.1	45.0	40.9	49.1
9 to 13	33.9	30.4	37.3	32.0	28.5	35.5
14 to 18	23.4	20.5	26.4	29.5*	26.5	32.5
19 to 30	27.9	24.5	31.3	37.4*	34.0	40.8
31 to 50	29.2	26.1	32.3	46.8*	43.6	50.1
51 to 70	40.2	37.3	43.2	60.3*	57.4	63.2
71 or older	44.9	40.5	49.3	60.1*	56.8	63.4

* significantly higher than males ($p<0.05$)
Source: 2004 Canadian Community Health Survey—Nutrition

Figure 1
Prevalence of vitamin/mineral supplement use, by household income group, age group and sex, household population aged 19 or older, Canada excluding territories, 2004



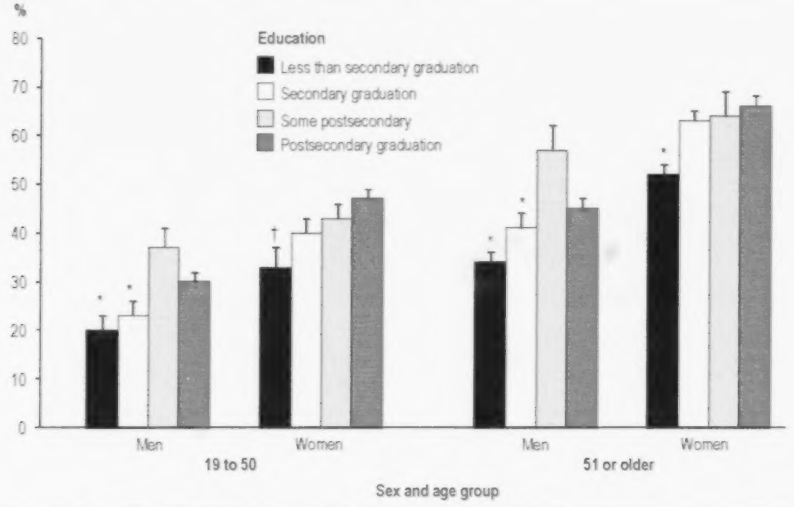
* significantly lower than highest income group ($p<0.05$)
Source: 2004 Canadian Community Health Survey—Nutrition

Table 2
Prevalence of vitamin/mineral supplement use, by food security status, age group and sex, household population aged 19 or older, Canada excluding territories, 2004

Age group/Sex	Food secure	Food insecure		
		Low	Moderate	Severe
	%	%	%	%
19 to 50				
Men	29 ± 1	27 ± 6	16 ± 5*	31 ± 13
Women	44 ± 1	39 ± 5	35 ± 6	23 ± 9*
51 or older				
Men	42 ± 1	19 ± 9*	13 ± 10*	31 ± 19
Women	60 ± 1	61 ± 8	48 ± 13	50 ± 17

* significantly different from food secure ($p<0.05$)
Source: 2004 Canadian Community Health Survey—Nutrition

Figure 2
Prevalence of vitamin/mineral supplement use, by education, age group and sex, household population aged 19 or older, Canada excluding territories, 2004



* significantly lower than some postsecondary and postsecondary graduation ($p<0.05$)
† significantly lower than postsecondary graduation ($p<0.05$)
Source: 2004 Canadian Community Health Survey—Nutrition.

use: even when the effects of the other variables were taken into account, the odds that people in the highest income households would take supplements were 1.6 times those of people in the lowest income households, and people with at least secondary graduation had 1.4 times the odds of taking supplements, compared with those who had not graduated from secondary school. The odds of taking supplements were significantly low among people with moderate food insecurity, compared with those who were food secure. People without chronic conditions were significantly less likely than those with chronic conditions to take supplements. No significant difference in supplement use emerged between rural and urban residents.

Calcium

The impact of taking supplements can be illustrated with calcium. Adequate intake (AI), the level that is considered to ensure nutritional adequacy, is 1,000 milligrams of calcium a day at ages 19 to 50, and rises to 1,200 milligrams a day at age 51 or older.[23]

Regardless of whether they took supplements, people in all age groups derived about the same amount of calcium from food (data not shown), and the majority were not meeting daily AI. The percentage meeting AI from food alone was highest (slightly more than 50%) among men aged 19 to 30, and lowest (less than 10%) among women older than 50 (Figure 3). In all age groups, higher percentages of men than women met AI based on diet alone.

The use of calcium supplements boosted the percentage of men and women of all ages meeting AI, but the effect was particularly pronounced among older women. For women aged 51 to 70, calcium intake from supplements increased the percentage at or above AI from 8% to 35%, and for those older than 70, from 5% to 29%. In fact, at these ages, higher percentages of women than men met calcium AI, a difference solely attributable to supplement use.

Discussion

The inverse supplement hypothesis,[9] which states that people at risk of nutritional inadequacy or in need of more nutrients because of disease risk are not the ones who take vitamin/mineral supplements, is supported by the CCHS data analysed in this study. In addition to sex and age, household income, education, food security status and having (a) chronic condition(s) were significantly related to supplement use.

The supplement use patterns reported here for Canadians resemble those of Americans, based on data from the 1999-2000 National Health and Nutrition Examination Survey (NHANES).[24] In both countries, a higher percentage of women than men used supplements; supplement use increased with age; and a higher level of education was positively associated with supplement use.[7,8,14,17]

Associations with household income and education in this and in an earlier

Table 3
Adjusted odds ratios showing factors associated with supplement use, by selected characteristics, household population aged 1 or older, Canada excluding territories, 2004

Characteristics	Adjusted odds ratio	95% confidence interval		p value
		from	to	
Age group/Sex				
1 to 8 (both sexes)†	1.00	...	...	...
9 to 18				
Male	0.59*	0.51	0.68	<0.0001
Female	0.62*	0.53	0.73	<0.0001
19 to 50				
Men	0.41*	0.33	0.50	<0.0001
Women	0.81*	0.67	0.98	0.032
51 or older				
Men	0.75*	0.62	0.91	0.004
Women	1.70*	1.50	2.10	<0.0001
Household income				
Lowest†	1.00	...	...	...
Lower-middle	1.00	0.83	1.20	0.91
Upper-middle	1.20	1.00	1.40	0.02
Highest	1.60*	1.30	1.90	<0.0001
Education				
Less than secondary graduation†	1.00	...	...	...
Secondary graduation or more	1.40*	1.20	1.70	<0.0001
Food security				
Food secure†	1.00	...	...	...
Food insecure				
Low	0.93	0.72	1.20	0.6
Moderate	0.71*	0.53	0.95	0.02
Severe	0.78	0.43	1.40	0.41
Chronic condition(s)				
Yes†	1.00	...	...	...
No	0.87*	0.77	0.99	0.014
Residence				
Rural†	1.00	...	...	...
Urban	1.00	0.90	1.10	0.8

† reference category
* significantly different from reference category (p<0.05)
... not applicable
Source: 2004 Canadian Community Health Survey—Nutrition

What is already known on this subject?

- Diet quality is linked to socio-economic status—higher-quality diets tend to be associated with greater affluence.
- Vitamin/Mineral supplements offer the possibility of improving micronutrient intake and achieving recommended levels among people who consume a nutrient-poor diet.
- Evidence points to a link between the use of supplements and income and education.

What does this study add?

- This is the first study based on nationally representative data to examine determinants of supplement use in Canada.
- In all age groups older than 14, a higher percentage of females than males took supplements.
- The prevalence of supplement use was highest among women aged 50 or older, at least 60% of whom reported taking vitamin/mineral supplements in the past month.
- Socio-economic gradients in supplement use were evident for most adult age/sex groups.
- These findings support the literature on supplement use from the United States and indicate a potential health disparity in access to vitamin/mineral supplementation.

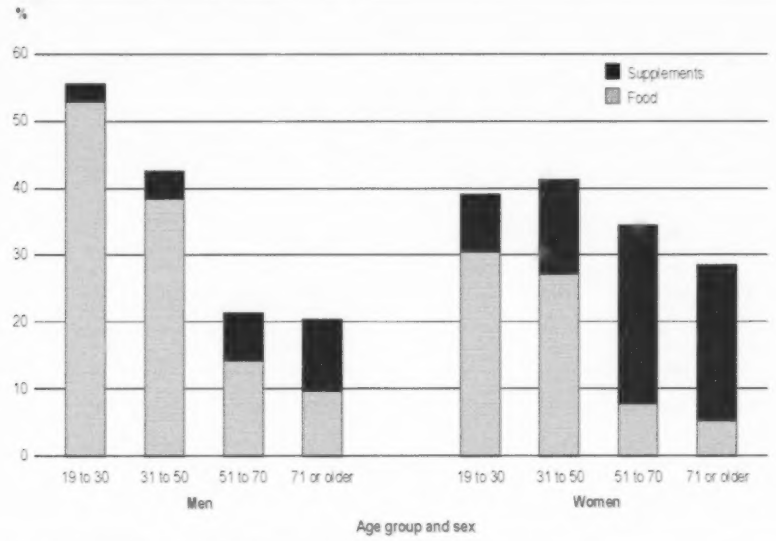
study,[24] and the additional relationship with food insecurity in this study, indicate relatively low supplement use among people of lower SES. As well, interviews and focus groups have revealed income, education, preferences, health issues and accessibility to be barriers to using supplements.[24]

A 2009 study[22] showed that Canadian adults' mean calcium intake from food alone was below recommended levels for most age/sex groups except young adult men, and that men had consistently higher intakes than women. In the present study, supplements had a relatively small impact on the percentage of men with adequate calcium intake, but the increase among women, particularly older women, was substantial, raising the percentage with adequate intake at least fourfold. In fact, because of the considerable amount of calcium older women derive from supplements, their total intake exceeded that of their male contemporaries.

Limitations

A limitation of this analysis is that the data on vitamin/mineral supplement use were self-reported and pertained to the month before the CCHS interview. By contrast, 24-hour recalls were used to collect data about food and beverage consumption. The second recall, in which about 30% of respondents participated, made it possible to reduce within-person variation to some extent and better estimate usual food and beverage consumption. With 83% of the CCHS respondents reporting daily use of supplements over the past month, it was assumed that this represented

Figure 3
Percentage meeting Adequate Intake for calcium from food and from food plus supplements, by age group and sex, household population aged 19 or older, Canada excluding territories, 2004



Source: 2004 Canadian Community Health Survey—Nutrition.

their usual practice. Nonetheless, the different data collection methods for food/beverage versus supplement intake, the different reference periods (previous day versus past month), and the lack of a within-person variability measure for supplement use could affect the estimate of total combined intake from food and from supplements. Unexpected results for some age/sex groups (for example, the high percentage of supplement users among men aged 19 to 30 in the lowest household income group) might be explained by high between-individual variability in supplement use, and possibly, by an irregular pattern of supplement use for clinical reasons in some subsets of respondents.

Conclusion

Data from the 2004 Canadian Community Health Survey provide evidence that SES indicators such as household income, education and food security are associated with vitamin/mineral supplement use, and that adults of lower SES are less likely to take supplements. This finding, consistent with research from the United States, reveals a potential health disparity with unequal uptake of vitamin/mineral supplementation.

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